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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/957,000	09/19/2001	Anisul Khan	005606/ETCH/SILICON/JB1	2442

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APPLIED MATERIALS, INC.  
2881 SCOTT BLVD. M/S 2061  
SANTA CLARA, CA 95050

EXAMINER
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AHMED, SHAMIM

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 03/13/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Applicati n No.

09/957,000

Applicant(s)

KHAN ET AL.

Examin r

Shamim Ahmed

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 19 September 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 18-23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2&4 6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

***Election/Restrictions***

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-17, drawn to a process, classified in class 216, subclass 67.
- II. Claims 18-23, drawn to product, classified in class 257, subclass 301.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case product can be made by different process such as performing a series of two process steps comprising wet and dry etching in an alternate fashion.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

4. During a telephone conversation with David Bonham on 3/6/03 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-17. Affirmation of this election must be made by applicant in replying to this Office action. Claims 18-23 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 1-17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Regarding claim 1, lines 6-11, the phrase "performing a series of at least two process steps upon said masked substrate, said series of at least two process steps comprising an isotropic plasma etching step; and repeating said series of at least two process steps-----, wherein said capacitor structure has etched sidewall with a undulating profile" renders the claim indefinite because it is unclear whether the series of the two process steps comprising only isotropic plasma etching or combination of isotropic and anisotropic plasma etching step.

It is also raises a question that is the repeating steps of isotropic plasma etching steps forming the capacitor structure has etched sidewall with a undulating profile or semi-corrugated profile?

**Remarks**

In the following rejections, examiner considering the series of at least two process steps comprising an isotropic and anisotropic plasma etching step in order to form a structure with a undulating profile or semi-corrugated profile as discussed in the specification (see paragraph 38 at page 10).

**Claim Rejections - 35 USC § 102**

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claims 1, 3-7 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Michaelis et al (6,103,585).

As to claims 1 and 3, 5, Michaelis et al disclose a process of making a deep trench capacitors, wherein a silicon substrate, to be etched to form trench is masked with a patterned masking layer having apertures (col.3, lines 16-22).

As to claim 4, Michaelis et al teach that the trench is formed on a silicon wafer having multiple layers. So, the etched structure is an elevated structure (col.3, lines 16-22).

Michaelis et al also disclose that a series of two process steps are performed in order to form a capacitor structure or trench has a multi-waist profile or in other words, trench with sidewall having an undulating profile (col.1, lines 65-67, col.4, lines 5-9 and figure 2).

As to claim 6, Michaelis et al teach that the series of at least two steps comprises an isotropic plasma etching step and a plasma deposition step (col.3, lines 59-67 and col. 4, lines 10-15).

As to claims 7 and 11, Michaelis et al teach that the isotropic etching is performed by using a gas mixture comprising  $\text{NF}_3$  (col.3, lines 41-47).

***Claim Rejections - 35 USC § 103***

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

12. Claims 2, 8-10, 12 and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michaelis et al (6,103,585) as applied to claims 1,3-7 and 11 above, and further in view of McReynolds (6,191,043).

As to claims 8-9 and 12, Michaelis et al discussed above in the paragraph 9 that the etching gas comprises HBr,  $\text{NF}_3$  and oxygen mixture but fail to discuss that the etching gas comprises a mixture of  $\text{SF}_6$ , HBr and oxygen.

However, in a method of making trench or opening in a silicon substrate, McReynolds teaches that  $\text{NF}_3$  can be substituted by  $\text{SF}_6$  (col.5, lines 17-20).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine McReynold's teaching into Michaelis et al's process because both the  $\text{NF}_3$  and  $\text{SF}_6$  are fluorine-containing and functionally equivalent during the plasma etching of silicon substrate as taught by McReynolds.

As to claim 2, McReynolds teaches that the vertical dimension or the etch depth of the trench is about 10 microns (col.5, lines 24-28). /

As to claim 10, it would have been obvious to one skilled in the art to optimize the ratio of the gases because the flow ratio of an etching composition appears to reflect a result-effective variable, which can be optimized. See MPEP 2144.05 IIB and further more, Michaelis et al teach that the flow rates of the gases can be used in a variety of alternative fashions (col.6, lines 9-12).

As to claim 16, it would have been obvious to one skilled in the art to optimize the plasma density because the plasma density appears to reflect a result-effective variable, which can be optimized. See MPEP 2144.05 IIB and further more, Michaelis et al teach that the etched profile can achieved by varying ratio of the gases that will eventually varying the plasma density (col.4, lines 24-30).

As to claim 17, McReynolds teaches that the etch rate is approximately 3.5 microns per minute and an average etch rate is approximately 1.6 microns per minute (col.5, lines 24-25 and lines 44-45).

13. Claims 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michaelis et al (6,103,585) as applied to claims 1, 3-7 and 11 above, and further in view of Laermer et al (6,284,148).

Michaelis et al discussed above in the paragraph 9 but fail to discuss that the deposition step is performed with the help of fluorocarbon gas or a fluorohydrocarbon gas.

However, in a method of etching silicon substrate during the formation of a trench with side wall, Laermer et al teach that a deposition step is alternatively performed after the etching step in order to protect the side wall of the trench during the subsequent etching process, wherein the gas comprises fluorocarbon or fluoro hydrocarbon gas such as  $\text{CHF}_3$  (col.4, lines 9-21 and lines 40-42).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Laermer et al's teaching into Michaelis et al's process for protecting the side wall of the trench during the subsequent etching process as taught by Laermer et al.

As to claim 15, Laermer et al teach that the passivation or depositing gas comprises  $\text{C}_4\text{F}_8$  (col.5, lines 24-25).



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**Conclusion**

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hung et al (6,071,823), Furukawa et al (6,190,988), Naeem et al (6,284,666) and Bronner et al (6,177,696) disclose a conventional process of making trench capacitor having substantial undulating profile.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (703) 305-1929. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703)-872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.



Shamim Ahmed  
Patent Examiner  
Art Unit 1765

SA  
March 08, 2003